LONG-RANGE WATER SUPPLY PLANNING FOR COBB COUNTY, GEORGIA

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INTRODUCTION

Since 1980, the Atlanta metropolitan area has encountered several of the driest summers on record. These frequently recurring summer drought conditions have resulted in mandatory water use restrictions and have focused the public's attention on the region's water supply as a potential issue of concern for the future. Although fall and winter rains have generally made up for the summer droughts, the recent short-term deficits in water supply availability have highlighted the fact that the region's water resources are limited and that effective management of these limited resources is essential if water supply availability is not to be a limiting factor in Atlanta's future growth.

The Cobb County-Marietta Water Authority (Authority) was created as a public utility in 1951 to furnish finished water on a wholesale basis to the municipal water systems of Marietta, Smyrna, Kennesaw, and Acworth, the Cobb County Water System, and Lockheed Aircraft Corporation. The Authority increased production from approximately 6.5 million gallons per day (mgd) in 1956 to an average of 70 mgd in 1987, making it the third largest water supplier in the metropolitan Atlanta area. Since its creation, the Authority's customer base has increased from the initial six customers, all located in Cobb County, to 14 customers, including six in neighboring counties.

As one of the major purveyors of finished drinking water in the Atlanta metropolitan area, the Authority has been, and will continue to be, involved in the implementation of regional water supply projects that benefit the Atlanta metropolitan area as a whole. To date, these projects have focused on the Lake Lanier/Chattahoochee River system as the primary source of water supply for the region. However, even with a proposed reallocation of storage in Lake Lanier, it is now generally recognized that this source will not be able to satisfy the projected water supply needs of the Atlanta area much beyond the year 2010. In response to this limitation, the Authority developed a conceptual work plan for a study to look beyond this planning horizon to the year 2040. The study investigated other surface water supply sources as well as more innovative options, such as groundwater, wastewater reuse, and water conservation, that could satisfy water demands in the Authority service area for the long-range future. In November 1987, the Authority retained Brown and Caldwell, Consulting Engineers to conduct the long-range water supply master plan study.

EXISTING WATER RESOURCES

The metropolitan Atlanta region relies heavily on surface water for its drinking water supplies. The northern portion of the region depends upon water from Lake Sidney Lanier and the Chattahoochee River system as well as on Lake Allatoona. Other raw water sources, including groundwater, supply less than 10 percent of metropolitan area water demands.

One of the primary objectives of this study was to identify and evaluate potential future sources of surface water supply to serve the Authority service area. The potential for developing additional surface water supplies is greatest to the north and west of Cobb County where land use is primarily rural in character. Three river basins predominate in this area: the Chattahoochee River basin, the Etowah River basin, and the Tallapoosa River basin.

Although approximately 90 percent of the water demand in the study area is supplied by surface water sources, significant supplies of groundwater are also potentially available. However, due to the geologic formations underlying Cobb County, careful site selection is necessary to obtain high yield wells. An inventory of Cobb County wells yielding greater than 20 gallons per minute (gpm) identified 467 wells with yields ranging from 20 gpm to 471 gpm (Cressler, et al., 1983). High yield wells are generally available only in areas of relatively high permeability, such as fault zones and zones of fracture concentration.

EXISTING WATER SYSTEM

Two raw water sources currently supply Authority demands: Lake Allatoona and the Chattahoochee River. Withdrawals from both sources are permitted by the Georgia Department of Natural Resources, Environmental Protection Division (EPD). The Authority is currently permitted to withdraw 58 mgd from the Chattahoochee River and 48 mgd from Lake Allatoona.

The Authority operates two water treatment facilities: the James E. Quarles Water Treatment Plant and the Hugh A. Wyckoff Water Treatment Plant. The Quarles Plant is located in eastern Cobb County and treats water withdrawn from the Chattahoochee River. The Wyckoff Plant is located in northwest Cobb County and treats water withdrawn from Lake Allatoona. Treatment process trains at the two plants are similar, consisting of screening, prechlorination, rapid mix, flocculation, sedimentation, filtration, and chlorination.

Finished water is delivered to 14 wholesale customers through an extensive transmission system. There are roughly 162 miles of finished water pipeline ranging in size from 16 inches to 60 inches in diameter. Storage facilities are located throughout the system for demand equalization, fire protection, and emergency conditions. Nine water storage tanks provide the Authority with 37 million gallons of finished water storage.

EXISTING AND FUTURE WATER REQUIREMENTS

Water demand in the Authority's service area has increased substantially, due primarily to the rapid growth of Cobb County in the late 1970s and early 1980s. In 1987, the Authority supplied an average of approximately 70 mgd of treated water to its wholesale customers. The maximum day demand for the year was approximately 108 mgd. During the summer of 1988, maximum day demand was approximately 114 mgd.

The maximum day peaking factor in the Authority service area has increased in recent years from about 1.47 in 1984 to about 1.56 in 1987. Although hydrologic conditions can affect the peaking factor to some degree, the upward trend over the last four years is indicative of increased water consumption by landscaping in new developments. This points out the need to effectively manage outdoor water use through public education and practices such as Xeriscaping (low water use landscaping). Even minor reductions in the maximum day peaking factor can result in major capital cost savings in the form of reduced water supply, treatment and transmission system capacity.

Table 1 summarizes long-term population and water demand projections for the Authority service area. The population of Cobb County is expected to more than double over the next 50 years, approaching a total of one million people. Maximum day water demand is projected to increase to over 330 mgd by the year 2040. This represents an increase of over 250 percent between the years 1990 and 2040.

Table 1. Cobb County Population and Water Demand Projections.

Year	Population	Maximum day water demand[a] (mgd)
1990	476,000[b]	129
2000	666,000[b]	189
2010	810,000[b]	245
2020	904,000[c]	287
2030	961,000[c]	314
2040	994,000[c]	333

[a] Water demand for the Authority service area.
[b] Source: Atlanta Regional Commission 1987 Regional Development Plan.
[c] Brown and Caldwell projections based on discussions with Cobb County.

WATER SUPPLY AND DEMAND REDUCTION OPTIONS

To develop alternative strategies for satisfying the increasing demand on the Authority water system, a variety of water supply and demand reduction options were identified and evaluated. These options included (1) expansion of existing and development of new surface water sources; (2) development of groundwater as a supplemental source of potable and nonpotable supply; (3) reuse of treated wastewater effluent, either indirectly from the receiving stream, or directly from the treatment plant in the form of reclaimed water; and (4) water conservation.

Surface Water Options

A total of 20 potential surface water options were evaluated. The maximum day yield from these options ranged from about 20 million gallons per day (mgd) for two small pumped storage projects to over 200 mgd for a large reservoir on the upper Etowah River. The present worth unit cost of these options, defined as total present worth of the project divided by the maximum day yield, ranged from about $2 to $4 million per mgd of capacity.

The least expensive surface water options, on a unit basis, were two small pumped storage projects. These options, however, are not large enough to play a major role in meeting the Authority's long-range water supply needs. Of the larger surface water supply options, purchases of additional capacity from Lake Allatoona and the Chattahoochee River were found to be the least costly, followed closely by construction of off-stream storage reservoirs on tributaries to the Etowah River upstream of Lake Allatoona. Slightly more expensive than these options were construction of larger reservoirs on the upper Etowah River itself.

Groundwater Options

Groundwater options evaluated in this study included (1) development of centralized groundwater systems for use as a supplemental source of potable water supply; and (2) development of decentralized groundwater systems for both residential and commercial/industrial nonpotable use. Groundwater yields in the Authority service area are typically low due to the geologic formations present. However, four general areas in Cobb County were identified where geologic conditions appear favorable for supporting centralized groundwater systems. The combined yield from wells in these four areas was estimated to be about 9 mgd. However, further geologic investigation and test well exploration will be needed in each area to better define actual yield potential. The cost of developing centralized groundwater systems for potable water supply purposes was estimated to be about $1.88 million per mgd of maximum day capacity. This is considerably less expensive on a unit basis than any of the surface water supply options evaluated in this study.

Decentralized groundwater systems for nonpotable water supply would require individual homeowners, developers, and commercial/industrial customers to install their own wells for irrigation purposes. The unit cost of such systems for commercial/industrial use is estimated to be about $2.43 million per mgd of maximum day capacity and is competitive economically with other water supply options. Implementation of this option in the short-term future also has the potential to reduce maximum day demand on the Authority system by about 58 mgd over the next 50 years. Decentralized nonpotable groundwater systems for residential use have the potential to reduce maximum day demand on the Authority system by only about 21 mgd and were found to be very costly on a unit basis because of the small amount of water that would actually be used from each residential well. However, it is expected that some customers will continue to install individual wells on their own to assure an adequate supply of water for irrigation during drought conditions.

Wastewater Reuse Options

The wastewater reuse options evaluated in this study were (1) indirect wastewater reuse from Cobb County's Robert L. Sutton and South Cobb Water Pollution Control

Plants (WPCPs) for potable water supply by means of surface withdrawal from the Chattahoochee River downstream of those discharges, and (2) production of reclaimed water as a source of nonpotable supply for distribution to residential and commercial customers through a dual piping system.

The indirect wastewater reuse option has the potential of providing as much as 40 mgd or more of additional potable water supply. However, this option would require granular activated carbon (GAC) treatment for organics removal and, therefore, is considerably more expensive than most other surface water options involving better water quality. The unit cost of this option was determined to be approximately $3.0 million per mgd of maximum day capacity. Use of a potable water supply source located immediately downstream from wastewater discharges could also be difficult from a public acceptance standpoint.

It was determined that large markets for reclaimed water do not presently exist in concentrated areas within close proximity to wastewater treatment plants in the Authority service area. However, the concept of a high quality supply of nonpotable water being available to the general public appears to have potential for the future. The unit cost of a 4-mgd demonstration project for production of reclaimed water at Cobb County's South Cobb WPCP and distribution to Six Flags and commercial/industrial areas in southeastern Cobb County was determined to be $1.6 million per mgd of maximum day capacity. This cost is economically competitive with the unit costs of other water supply options evaluated in this study. In the future, the combined benefits from reduced water supply requirements and reduced wasteloads to the Chattahoochee River may make this option much more economically attractive.

Water Conservation

All of the water conservation options considered in this study were found to be less expensive than any of the water supply options. This is a clear indication that it is less costly to reduce demand through conservation than it is to satisfy increased demand with additional supply. Of all the water conservation options considered in this study, the most cost-effective was determined to consist of a public education program combined with a program to require water efficient landscaping for both residential and commercial/industrial development. Implementation of this option has the potential to reduce maximum day demand on the Authority service area by 41 mgd by the year 2040. The unit cost of this water conservation option was estimated to be $0.14 million per mgd of maximum day demand reduced.

LONG-RANGE WATER SUPPLY ALTERNATIVES

The most cost-effective individual water supply options were combined to develop long-range water supply alternatives for the Authority service area. Six such alternatives were identified and evaluated on the basis of both economic and noneconomic factors.

Development of Alternatives

In developing long-range alternatives for the Authority service area, the cost of individual options was a primary factor. However, other factors also played a role. These included (1) the Authority's commitment to participate in the regional Lake Lanier storage reallocation project, (2) the availability of options with respect to short-term and long-term implementation requirements, (3) the capacity of options and their ability to satisfy projected demands, and (4) the compatibility of options with respect to timing and size of planned Authority treatment plant expansions.

Six long-range water supply alternatives were developed to evaluate different approaches to satisfying future water demands in the Authority service area. They were also developed to evaluate alternatives to increasing withdrawals from Lake Allatoona should the cost of purchasing storage in that facility be significantly higher than currently anticipated. Specifically, the six long-range water supply alternatives were as follows:

Alternative 1 -- Use of existing water supply sources only, assuming no water conservation measures are implemented.
Alternative 2 -- Use of existing water supply sources only, assuming water conservation measures are implemented for demand reduction.
Alternative 3 -- Use of existing water supply sources with water conservation, supplemented with groundwater for potable supply only.
Alternative 4 -- Use of existing sources with water conservation, supplemented with groundwater for both potable and nonpotable supply.
Alternative 5 -- Maximum use of water supply sources other than Lake Allatoona, using groundwater for both potable and nonpotable supply.
Alternative 6 -- Maximum use of water supply sources other than Lake Allatoona, using groundwater for potable supply only.

Evaluation of Alternatives

Table 2 summarizes the results of the economic and noneconomic evaluation of the six long-range water supply alternatives.

Table 2. Alternative Analysis Results.

Alternative	Total present worth,[a] million dollars: Authority only	Total present worth,[a] million dollars: Total	Noneconomic rating
1	313.1	313.1	Good
2	256.6	256.6	Very good
3	253.6	253.6	Very good
4	177.7	259.6	Very good
5	226.3	265.4	Very good
6	260.7	260.7	Good

[a] Includes cost escalation at the rate of 5 percent per year and discounting at the rate of 7.25 percent per year.

Both the cost to be borne by the Authority and the total cost to be borne by the community for each of the long-range alternatives are reflected in Table 2. The difference in the two costs for Alternatives 4 and 5 is the cost of the non-

potable groundwater systems in those two alternatives, assumed to be paid for by the private sector.

While cost is a major factor in selection of a long-range water supply plan, there are noneconomic factors that must be considered as well. Noneconomic factors applicable to the development of future water supplies to serve the Authority service area include flexibility, reliability, implementability, institutional compatibility, water quality and environmental impacts. On the whole, the alternatives were closely rated with respect to overall noneconomic considerations. No overriding noneconomic factors were identified that would clearly eliminate any of the alternatives.

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of this study, the most attractive alternative for meeting long-term water demands in the Authority service area is Alternative 3. This alternative takes advantage of the economics of water conservation and provides for use of relatively inexpensive groundwater as a source of supplemental potable water supply. Furthermore, it allows projected water demands to be satisfied through the year 2040 with full utilization of the Authority's share of currently proposed allocations of additional water supply from the Chattahoochee River and Lake Allatoona. It is the least costly overall of the six long-range alternatives evaluated and compares favorably with other alternatives with respect to noneconomic factors.

A different approach to satisfaction of long-term water demands, and one which may actually be more attractive economically to the Authority, is represented by Alternative 4. Alternative 4 relies heavily on the development of groundwater irrigation systems by new commercial/industrial customers. Demand on the Authority system is reduced considerably and, consequently, Alternative 4 results in the least cost to the Authority. However, Alternative 4 may be difficult to implement if groundwater is not available in sufficient quantities to support large irrigation systems or if regulations are not passed requiring that the groundwater systems be constructed. Additionally, if economic incentive or reimbursement programs are required to obtain the necessary participation in the groundwater program, Alternative 4 may not be as economically attractive to the Authority.

Specific recommendations for actions to be taken by the Authority related to implementation of a long-range water supply strategy include the following:

1. Participation in the Lake Lanier storage reallocation project to obtain an additional 52 mgd of maximum day withdrawal capacity from the Chattahoochee River.
2. Initiation of a water conservation public education program and investigation into the feasibility of regulations requiring water efficient landscaping in new residential and commercial/industrial developments.
3. Commissioning of geologic and hydrogeologic investigations to further quantify groundwater yield potential.
4. Conceptual design of off-stream storage reservoirs on the upper Etowah River to refine yield analyses and facilities costs.
5. Investigation of the feasibility of regulations requiring groundwater irrigation systems for new commercial/industrial developments.
6. Coordination with the Cobb County Water System to implement a reclaimed water demonstration project.

LITERATURE CITED

Cressler, C.W., Thurmond, W.J., and Hester, W.G., 1983, Groundwater in the Greater Atlanta Region, Georgia, Georgia Geological Survey Information Circular 63, Atlanta, Georgia.

Atlanta Regional Commission, October 1987, Regional Development Plan, Census Tract Forecast, 1990, 2000, 2010.